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(71) Applicant : **GOLDSTAR CO. LTD.**
20, Yoido-Dong
Yongdungpo-Ku
Seoul (KR)

(72) Inventor : **Soo, Kyung Kim**
237-188, Sinsa-Dong,
Eunpyung-Ku
Seoul (KR)
Inventor : **Mun, Chae Joung**
309-1, Myungil-Dong Samick Apt. 105-115
Kangdong-Ku, Seoul (KR)
Inventor : **Yong, Hoo Shin**
Kwonsun-Dong,
Kwonsun Apt.210-402,
Kwonsun-Ku
Suwon, Kyunki-Do (KR)
Inventor : **Man, Chul Choi**
660-4, Kaepo 1-Dong Jukong Apt.59-402,
Kangnam-Ku
Seoul (KR)
Inventor : **Yoon, Seok Seoh**
17, Sadang-Dong Woosung Apt.304-503,
Dongjak-Ku
Seoul (KR)
Inventor : **Soon, Ki Lim**
674-33, Balsan 2-dong,
Kangseo-Ku
Seoul (KR)
Inventor : **Joong, Kwon Joh**
Ssangmoon 4Dong Sungwon Apt.107-104,
Dobong-Ku
Seoul (KR)

(74) Representative : **Jacquelin, Marc-Henri et al**
Cabinet PLASSERAUD,
84, rue d'Amsterdam
F-75440 Paris Cédex 09 (FR)

(54) Apparatus for recording and reproducing digital/analog video signals.

(57) An apparatus for recording and reproducing digital/analog video signals including a single head drum attached with heads for processing analog video signals and heads for processing digital video signals, and switches performing switching operations on the basis of the kind of input video signals. The head drum is variable in speed, depending on the kind of input video signals.

In accordance with the apparatus, both of analog and digital signals can be recorded and reproduced by a single recording unit and a single reproducing unit both capable of varying in characteristic, based on a video signal received thereto. This provides a reduction in manufacture cost and a light, thin, simple and compact construction of the existing VCRs.

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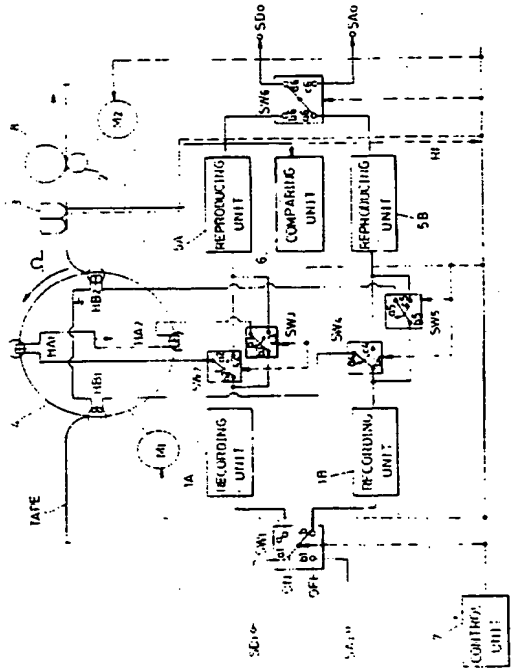
FIG. 2



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an apparatus for recording and reproducing digital/analog video signals, and more particularly to an apparatus for recording and reproducing digital/analog video signals, capable of achieving record and reproduction of both a digital video signal and an analog video signal, thereby exhibiting a compatibleness with the existing VHS system.

Description of the Prior Art

On tapes for VCRs of the VHS system capable of recording NTSC broadcast signals and PAL broadcast signals, analog video signals are recorded. These video signals are recorded with a band of 5MHz in VHF cases and with a band of 7MHz in SVHS cases.

For recording analog video signals with a band of 5 to 7MHz, conventional VCRs include a pair of video heads, an amplifier for record and reproduction of analog video signals, and a signal processing circuit. A relative head drum speed corresponding to a recording wavelength of the video signals is 5.8m/s (1,800rmm in a case of a head drum having a diameter of 62mm).

Where digital video signals are used as receivable signals of high definition televisions (HDTVs), they should be recorded at a higher density than that of analog video signals because of their large data amount (at least 5 times that of analog video signals).

For recording digital video signals with a band of about 15MHZ, digital video signal-recordable VCRs include at least one pair of video heads, an amplifier for record and reproduction of digital video signals, and a signal processing circuit. A relative head drum speed corresponding to a recording wavelength of the video signals is 11.6m/s (3,600rpm in a case of a head drum having a diameter of 62mm).

However, conventional VCRs capable of recording analog video signals can not reproduce tapes on which digital video signals are recorded. On the other hand, existing digital VCRs capable of recording digital video signals can not reproduce tapes on which analog video signals are recorded. In other words, conventional VCRs have no compatibleness for digital and analog signals. As a result, there has been a problem that separate VCRs should be provided for record/reproduction of an analog vide signal and a digital video signal, respectively.

SUMMARY OF THE INVENTION

Therefore, an object of the invention is to provide an apparatus for recording and reproducing digital/analog video signals, having a compatibleness capable of achieving record and reproduction of both a digital video signal and an analog video signal.

Another object of the invention is to provide an apparatus for recording and reproducing digital/analog video signals, capable of recording digital video signals on a tape for record and reproduction of analog video signals, thereby enabling the use of a tape of the existing VHS type or SVHS type as it is.

In accordance with the present invention, this object can be accomplished by providing an apparatus for recording and reproducing digital/analog video signals, comprising: an input switch for selecting one of an analog video signal and a digital video signal inputted in a record mode; a recording unit for processing said video signal selected by a switching operation of said input switch to record the video signal on a tape; head means for recording a video signal on said tape and reproducing said video signal recorded on the tape, said head means having an analog video signal-processing head portion and a digital video signal-processing head portion; switching means for selecting one of said head portions to record the video signal outputted from said recording unit on the tape and reproduce said video signal outputted from the head means; a capstan for rotating a capstan motor in accordance with a mode selected by a user and feeding the tape by the rotation of said capstan motor; an audio/control head for generating a control signal on the basis of said video signal recorded on the tape being fed and performing a record mode or a play mode; a head drum rotating by a drum motor to record or reproduce an analog video signal and a digital video signal through said head means during its rotation; a reproducing unit for receiving said video signal from the head means through said switch;ng means and reproducing the received video signal; a comparing unit for controlling an output signal of said reproducing unit with said control signal of said audio/control head to check whether said output signal of the reproducing unit is an analog video signal or a digital video signal; an output switch for selectively outputting the output signal of the reproducing unit in accordance with a control signal outputted from said comparing unit; and a control unit for outputting control signals for said units of the apparatus in accordance with a selected operation mode.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and aspects of the invention will become apparent from the following description of embodiments with reference to the accompanying drawings in which:

FIG. 1 is a schematic view of a head drum employed in accordance with the present invention;

FIG. 2 is a block diagram of an apparatus for recording and reproducing digital/analog video sig-

nals in accordance with a first embodiment of the present invention;

FIGS. 3A and 3B are schematic views respectively illustrating patterns of video signals recorded on tapes, in which FIG. 3A is for analog video signals while FIG. 3B is for digital video signals;

FIGS. 4A to 4L are waveform diagrams of various signals outputted from various units of FIG. 2 in a play mode; and

FIG. 5 is a block diagram of an apparatus for recording and reproducing digital/analog video signals in accordance with a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 2 is a block diagram of an apparatus for recording and reproducing digital/analog video signals in accordance with a first embodiment of the present invention.

As shown in FIG. 2, the apparatus comprises a switch SW_1 for selecting one of an analog video signal SA_i and a digital video signal SD_i inputted in a record mode, a pair of recording unit 1A and 1B for processing the analog video signal SA_i and the digital video signal SD_i selected by the switching operation of the switch SW_1, respectively, two pairs of switches, one pair including two switches SW_2 and SW_3 each adapted to select a corresponding head for recording the analog video signal SA_i on a tape and the other pair including two switches SW_4 and SW_5 each adapted to select a corresponding head for recording the digital video signal SD_i, and two pairs of heads, one pair including two heads HA_1 and HA_2 respectively adapted to record the analog video signal SA_i passing through the switches SW_2 and SW_3 and the other pair including two heads HB_1 and HB_2 respectively adapted to record the digital video signal DA_i passing through the switches SW_4 and SW_5. The apparatus further comprises a capstan 2 for rotating a capstan motor M_2 in accordance with a mode selected by the user and feeding the tape by the rotation of the capstan motor M_2, an audio/control head 3 for outputting a control signal Ctl on the basis of video signals recorded on the tape being fed and performing a record mode or a play mode, a head drum 4 adapted to rotate by a drum motor M_1, and record or reproduce the analog video signal SA_i and the digital video signal SD_i through the heads HA_1, HA_2, HB_1 and HB_2 during its rotation, a pair of reproducing units 5A and 5B, one adapted to reproduce and process video signals respectively received from the heads HA_1 and HA_2 via the switches SW_2 and SW_3 switched on in the play mode and the other adapted to reproduce and process video signals respectively received from the heads HB_1 and HB_2 via the switches SW_4 and SW_5 switched on in the play mode, a comparing unit for comparing each of output signals from the reproducing unit 5A and 5B with the control signal Ctl from the audio/control head 3 and checking whether the compared output signal is an analog video signal or a digital video signal, on the basis of the comparison, a switch SW_6 for selecting one of outputs SA_0 and SD_0 of the reproducing units 5A and 5B in accordance with a control signal from the comparing unit 6, and a control unit 7 for outputting control signals for various units of the apparatus.

In FIG. 2, the reference numeral 8 denotes a pinch roller for feeding the tape.

Each of the recording units 1A and 1B comprises a pre-amplifier, a modulator and an equalizer. As shown in FIG. 1, the head drum 3 is attached with the heads HA_1, HB_1, HA_2 and HB_2 spaced from one another at an angle of 90°. Together with two guide posts 9A and 9B, the head drum 3 serves to maintain the tape at an azimuth angle of at least 180°. To the head drum 3, a phase generator is also attached. Based on a detect signal from the phase generator, switching operations of the switches SW_2 to SW_6 are achieved. The detect signal of the phase generator is also used for the selection of the heads HA_1, HA_2, HB_1 and HB_2.

The heads HA_1 and HA_2 are heads arranged at an angle of 180° with respect to each other and adapted to record and reproduce analog signals. Each of heads HA_1 and HA_2 has an azimuth angle of ±6°. On the other hand, the heads HB_1 and HB_2 are heads arranged at an angle of 180° with respect to each other and adapted to record and reproduce digital signals. Each of heads HB_1 and HB_2 has an azimuth angle of ±15° and a phase angle of 90° with respect to the heads HA_1 and HA_2.

For recording video signals in the recording/reproducing apparatus having the above-mentioned arrangement, the switch SW_1 is switched in accordance with a control signal from the control unit 7 to select one of an analog video signal SA_i and a digital video signal SD_i. The selected video signal is then applied to a corresponding one of the recording units 1A and 1B. At this time, the switches SW_2, SW_3, SW_4 and SW_5 are switched so that their fixed contacts a_2, a_3, a_4 and a_5 can be connected with their movable contacts b_2, b_3, b_4 and b_5, respectively.

When the digital video signal SD_i is recorded, the switch SW_1 is switched to obtain a connection between its contacts a_1 and d_1. As a result, the digital video signal SD_1 is fed to the recording unit 1B and then modulated after being amplified to a predetermined level. The modulated video signal denoted by the reference character V_2 is applied from the recording unit 1B to the heads HB_1 and HB_2 for digital signals via the switches SW_4 and SW_5 switched on under a control of the control unit 7.

As the capstan 2 rotates by the capstan motor M_2, a tape is fed at a speed corresponding to a half of a

recording speed Vt for analog video signals. During the travel of the tape, the modulated video signal V_2 is recorded on the tape, as shown in FIG. 3A. Also, a control signal Ctl B shown in FIG. 4A is recorded on the lower track end 302 of the tape by the audio/control head 3.

As mentioned above, input digital video signals SD_i are recorded on inclined tracks 303a and 303b having a constant track pitch T_p and an azimuth angle of ±15°, as shown in FIG. 3A. Control signal Ctl B are recorded on the lower track end 302 of the tape. On the other hand, audio signals are recorded on the upper track end 301 of the tape.

When the analog video signal SA_i is recorded, the switch SW_1 is switched to obtain a connection between its contacts b_1 and c_1. As a result, the analog video signal SA_1 is fed to the recording unit 1A which, in turn, modulates the analog video signal SA_i. The modulated video signal denoted by the reference character V_1 is applied from the recording unit 1A to the heads HA_1 and HA_2 for analog signals via the switches SW_2 and SW_3 switched on under a control of the control unit 7. The modulated video signal V_1 is then recorded on a tape being fed at a normal speed V_t, as shown in FIG. 3B. Also, a control signal Ctl A shown in FIG. 4B is recorded on the lower track end 306 of the tape.

Input digital video signals SA_i are recorded on inclined tracks 307a and 307b having a track pitch corresponding to twice the track pitch T_p of the tracks 303a and 303b and an azimuth angle of ±6°, as shown in FIG. 3B. Control signals Ctl A are recorded on the lower track end 306 of the tape. The recording of control signals Ctl A is accomplished in a manner that the recorded signals can be compatible with the tape patterns of the existing VHS standard.

By the drum driving motor M_1 driven in accordance with the control signal from the control unit 7, the head drum 4 rotates at a rate of 3,600rpm in cases of digital video signals and at a rate of 1,800rpm in cases of analog video signals.

For reproducing video signals recorded in the above-mentioned manner, the switches SW_2, SW_3, SW_4 and SW_5 are switched so that their fixed contacts a_2, a_3, a_4 and a_5 can be connected with their movable contacts c_2, c_3, c_4 and c_5, respectively. By such switching operations of the switches SW_2, SW_3, SW_4 and SW_5, video signals reproduced by the heads HA_1, HA_2, HB_1 and HB_2 are applied to and processed by corresponding reproducing units 5A and 5B, respectively.

At the same time, the audio/control head 3 detects control signals Ctl from the tape being fed. Together with each reproduced video signal, each control signal Ctl is applied to the comparing unit 6. The comparing unit 6 compares the received signals with each other. When the reproduced video signal is a digital video signal, the comparing unit 6 outputs a reference signal Rf B as shown in FIG. 4C. When the reproduced video signal is an analog video signal, the comparing unit 6 outputs a reference signal Rf A as shown in FIG. 4D.

The control unit 7 receives the reference signal which is one of the signals Rf A and Rf B and discriminates whether the reproduced video signal is an analog video signal or a digital video signal. The control unit 7 outputs a control signal corresponding to the discrimination result. By the control signal from the control unit 7, the switch SW_6 is switched to select one of outputs V_3 and V_4 of the reproducing units 5A and 5B. The SW_2 to SW_5 are also appropriately switched by the control signal from the control unit 7. The drum motor M_1 and the capstan motor M_2 are controlled by the reference signal Rf A or Rf B of the comparing unit 5 to rotate at respective appropriate speeds corresponding to the recorded video signal.

By the control signal from the control unit 7, the phase generator equipped in the head drum 4 is driven to output a detect signal for switching the switches SW_2 to SW_5. Detect signals for a digital video signal and an analog video signal are shown in FIGS. 4E and 4F, respectively.

As shown in FIG. 4E, the detect signal takes precedence in phase by a predetermined time t_a, over a digital video signal outputted from the head HB_1. On the other hand, the detect signal shown in FIG. 4F takes precedence in phase by a predetermined time t_b, over an analog video signal outputted from the head HA_1.

As the phase generator outputs the detect signal shown in FIG. 4E, the control unit 7 generates a switching signal HSW as shown in FIG. 4G. By the switching signal HSW, the switches SW_4 and SW_5 are switched respectively to send the digital video signals reproduced in the heads HB_1 and HB_2, as shown in FIGS. 4H and 4I, to the reproducing unit 5B which, in turn, demodulates the digital video signals. The demodulated digital video signals are outputted from the reproducing unit 5B via the switch SW_6 in which its contacts a_6 and d_6 are connected to each other.

The reproduced digital video signals outputted from the reproducing unit 5B are displayed on a screen as HDTV image signals SD_0.

As the phase generator outputs the detect signal shown in FIG. 4F, the control unit 7 generates a switching signal 1/2HSW as shown in FIG. 4G. By the switching signal 1/2HSW, the switches SW_2 and SW_3 are switched respectively to send the analog video signals reproduced in the heads HA_1 and HA_2, as shown in FIGS. 4K and 4L, to the reproducing unit 5A which, in turn, demodulates the analog video signals. The demodulated analog video signals are outputted from the reproducing unit 5A via the switch SW_6 in which its contacts b_6 and c_6 are connected to each other.

The reproduced analog video signals outputted

from the reproducing unit 5A are displayed on a screen as NTSC image signals SA_0.

FIG. 5 is a block diagram of an apparatus for recording and reproducing digital/analog video signals in accordance with a second embodiment of the present invention.

As shown in FIG. 5, the apparatus comprises a switch SW_1, two pairs of switches, one pair including two switches SW_2 and SW_3 and the other pair including two switches SW_4 and SW_5, two pairs of heads, one pair including two heads HA_1 and HA_2 and the other pair including two heads HB_1 and HB_2, a capstan motor M_2, a capstan 2, an audio/control head 3, a head drum 4, a drum motor M_1, a recording unit 1A, a reproducing unit 5a, a comparing unit 6, a control unit 7, a current control unit 9 for varying the amount of current applied to the recording unit 1A under a control of the control unit 7, and an automatic gain control unit 10 for automatically controlling a gain of a video signal reproduced in the reproducing unit 5A in accordance with a control signal generated from the control unit 7. In accordance with this embodiment, the switch SW_1, the switches SW_2, SW_3, SW_4 and SW_5, the heads HA_1, HA_2, HB_1 and HB_2, the capstan motor M_2, the capstan 2, the audio/control head 3, the head drum 4, the drum motor M_1, the recording unit 1A, the reproducing unit 5a, the comparing unit 6 and control unit 7 have the same constructions as those in the first embodiment. In accordance with the second embodiment, the recording unit 1B and the reproducing unit 5B used in the apparatus of the first embodiment are omitted.

For recording video signals in the recording/reproducing apparatus having the above-mentioned arrangement, the switch SW_1 is switched in accordance with a control signal from the control unit 7 to select one of an analog video signal SA_i and a digital video signal SD_i. The selected video signal is then applied to the recording unit 1A.

At this time, the control signal outputted from the control unit 7 is controlled in current amount by the current control unit 9. The controlled current I_1 is then applied to the recording unit 1A to convert the band and characteristic of the selected video signal received in the recording unit 1A.

In other words, the amount of the current I_1 is varied, depending on the kind of the selected video signal. As a result, the recording unit 1A has a band and a characteristic both varied in accordance with the current I_1 varied in amount. Accordingly, the input video signal is modulated with the varied band and characteristic.

The modulated video signal V_1 is then applied to selected ones of the heads HA_1, HA_2, HB_1 and HB_2 via selected ones of the switches SW_2, SW_3, SW_4 and SW_5 to be recorded on a tape being fed. This procedure is the same as that of the first embodiment.

For reproducing video signals recorded in the above-mentioned manner, the switches SW_2, SW_3, SW_4 and SW_5 are switched so that their fixed contacts a_2, a_3, a_4 and a_5 can be connected with their movable contacts c_2, c_3, c_4 and c_5, respectively. By such switching operations of the switches SW_2, SW_3, SW_4 and SW_5, video signals reproduced by the heads HA_1, HA_2, HB_1 and HB_2 are applied to and processed by the reproducing unit 5A.

At the same time, the audio/control head 3 detects control signals Ctl from the tape being fed. Together with each reproduced video signal, each control signal Ctl is applied to the comparing unit 6. The comparing unit 6 compares the received signals with each other. When the reproduced video signal is a digital video signal, the comparing unit 6 outputs a reference signal Rf B as shown in FIG. 4C. When the reproduced video signal is an analog video signal, the comparing unit 6 outputs a reference signal Rf A as shown in FIG. 4D.

The control unit 7 receives the reference signal which is one of the signals Rf A and Rf B and discriminates whether the reproduced video signal is an analog video signal or a digital video signal. The control unit 7 outputs a control signal corresponding to the discrimination result. By the control signal from the control unit 7, the video signal reproduced in the reproducing unit 5A is applied to the automatic gain control unit 10 which, in turn, controls the gain of the video signal. The gain of the video signal is varied, based on a corresponding one of a digital video signal band and an analog video signal band.

Thereafter, the video signal varied in gain is demodulated and then outputted. This procedure is the same as that of the first embodiment.

Although two pairs of heads are used for an analog video signal and a digital video signal, respectively, only one pair of heads may be used for both the analog video signal and the digital video signal by varying the amount of current applied to the heads.

As apparent from the above description, the present invention provides an apparatus for recording and reproducing digital/analog video signals, capable of achieving record and reproduction of both a digital video signal and an analog video signal by use of one head drum. Accordingly, it is possible to reproduce tapes of the existing analog type and yet maintain the function of high definition digital VCRs.

In accordance with the present invention, both the analog signal and the digital signal can be recorded and reproduced by a single recording unit and a single reproducing unit both capable of varying in characteristic, based on a video signal received thereto. This provides a reduction in manufacture cost and a light, thin, simple and compact construction of the existing VCRs.

Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various

modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. An apparatus for recording and reproducing digital/analog video signals, comprising:

an input switch for selecting one of an analog video signal and a digital video signal inputted in a record mode;

a recording unit for processing said video signal selected by a switching operation of said input switch to record the video signal on a tape;

head means for recording a video signal on said tape and reproducing said video signal recorded on the tape, said head means having an analog video signal-processing head portion and a digital video signal-processing head portion;

switching means for selecting one of said head portions to record the video signal outputted from said recording unit on the tape and reproduce said video signal outputted from the head means;

a capstan for rotating a capstan motor in accordance with a mode selected by a user and feeding the tape by the rotation of said capstan motor;

an audio/control head for generating a control signal on the basis of said video signal recorded on the tape being fed and performing a record mode or a play mode;

a head drum rotating by a drum motor to record or reproduce an analog video signal and a digital video signal through said head means during its rotation;

a reproducing unit for receiving said video signal from the head means through said switching means and reproducing the received video signal;

a comparing unit for controlling an output signal of said reproducing unit with said control signal of said audio/control head to check whether said output signal of the reproducing unit is an analog video signal or a digital video signal;

an output switch for selectively outputting the output signal of the reproducing unit in accordance with a control signal outputted from said comparing unit; and

a control unit for outputting control signals for said units of the apparatus in accordance with a selected operation mode.

2. An apparatus in accordance with claim 1, wherein each of said input switch and said output switch has two switching positions respectively corresponding to said analog video signal and said digital video signal.

3. An apparatus in accordance with claim 1, said switch means has four switching positions respectively for connecting an output of said recording unit to said digital signal-processing head portion of said head means in the record mode, for connecting said output of the recording unit to said analog signal-processing head portion of the head means in the record mode, for connecting the digital signal-processing head portion of the head means to said reproducing unit in the reproducing mode, and for connecting the analog signal-processing head portion of the head means to the reproducing unit in the reproducing mode.

4. An apparatus in accordance with claim 1, wherein said head means comprises four heads attached to said head drum and spaced from one another at an angle of 90° to define a phase angle of 90° between adjacent heads, two facing ones of said heads constituting said analog signal-processing head portion and the other two facing heads constituting said digital signal-processing head portion.

5. An apparatus in accordance with claim 1, further comprising:

a current control unit for varying an amount of current applied to said recording unit under a control of said control unit; and

an automatic gain control unit for automatically controlling a gain of said video signal reproduced in said reproducing unit under a control of the control unit.

6. An apparatus in accordance with claim 1, wherein said head means comprises a single head constituting both said analog video signal-processing head portion and said digital video signal-processing head portion, and means for varying an amount of current to be applied to said head means such that the analog video signal-processing head portion and the digital video signal-processing head portion receive different amounts of current.

FIG.1

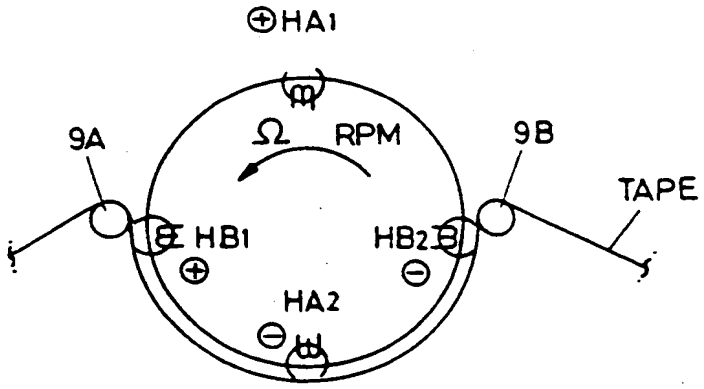
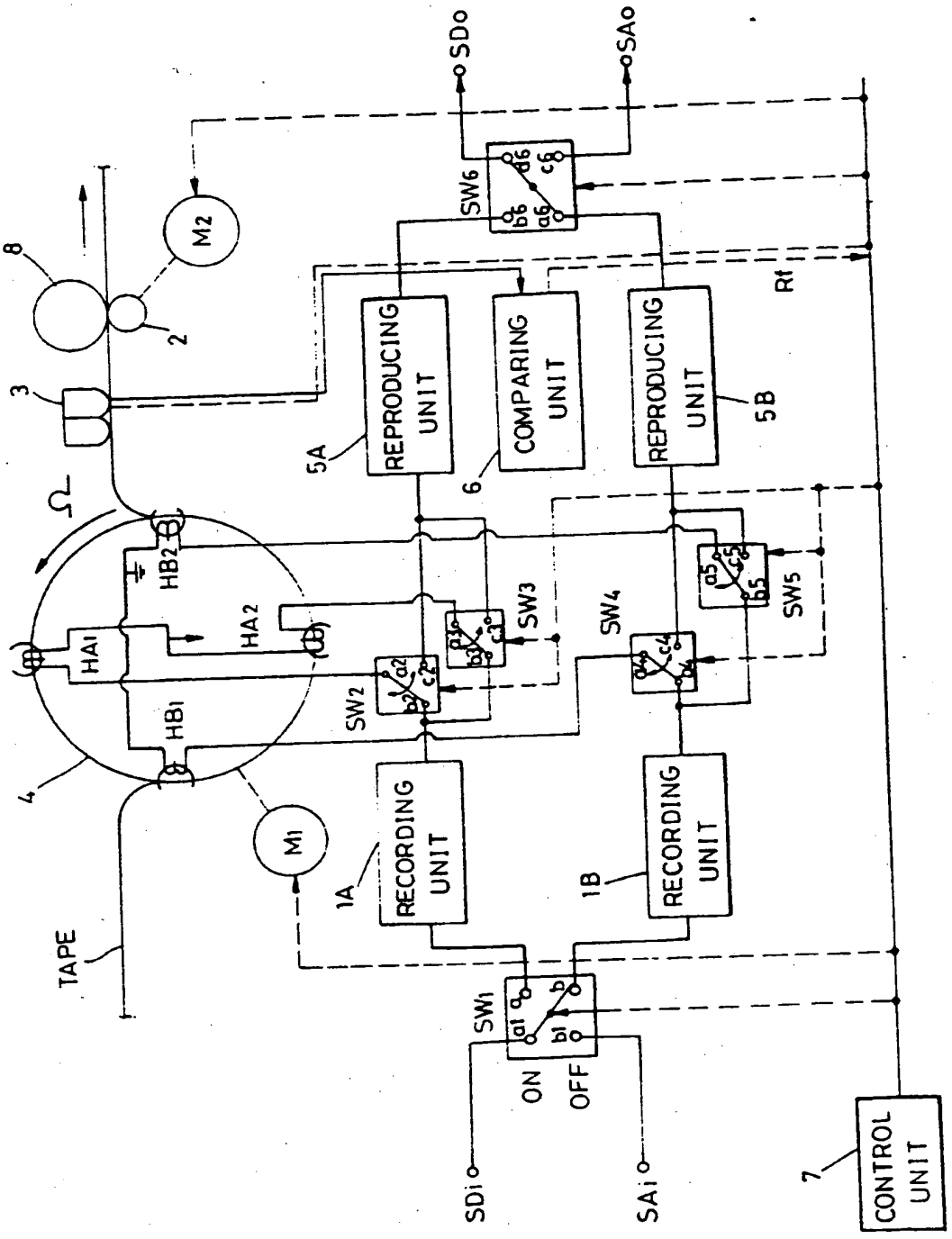


FIG. 2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SAo
SW6
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8
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3
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COMPARING UNIT
6
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Rf
HB2
HA2
HA1
HB1
SW3
SW4
SW5
SW2
4
M1
RECORDING UNIT
1A
RECORDING UNIT
1B
TAPE
SW1
ON
OFF
SDi
SAi
CONTROL UNIT
7

FIG. 3A

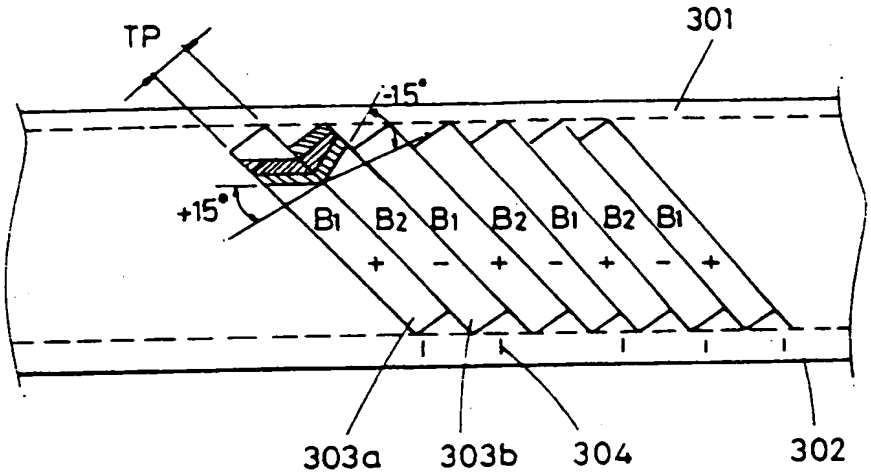
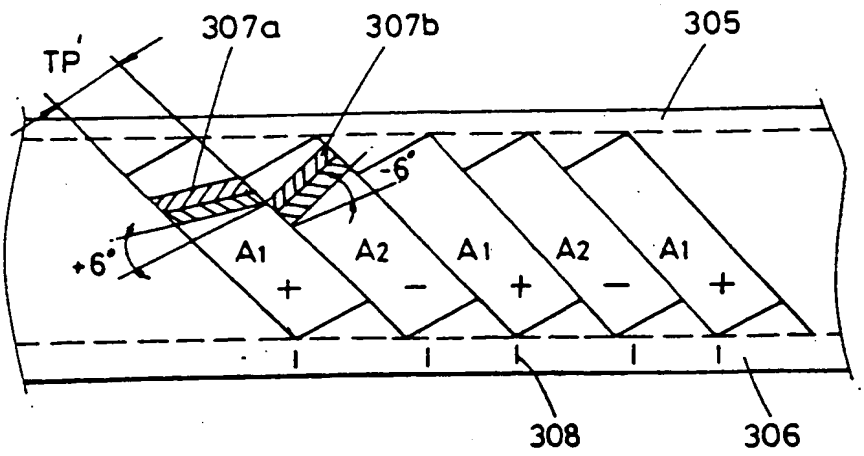


FIG. 3B



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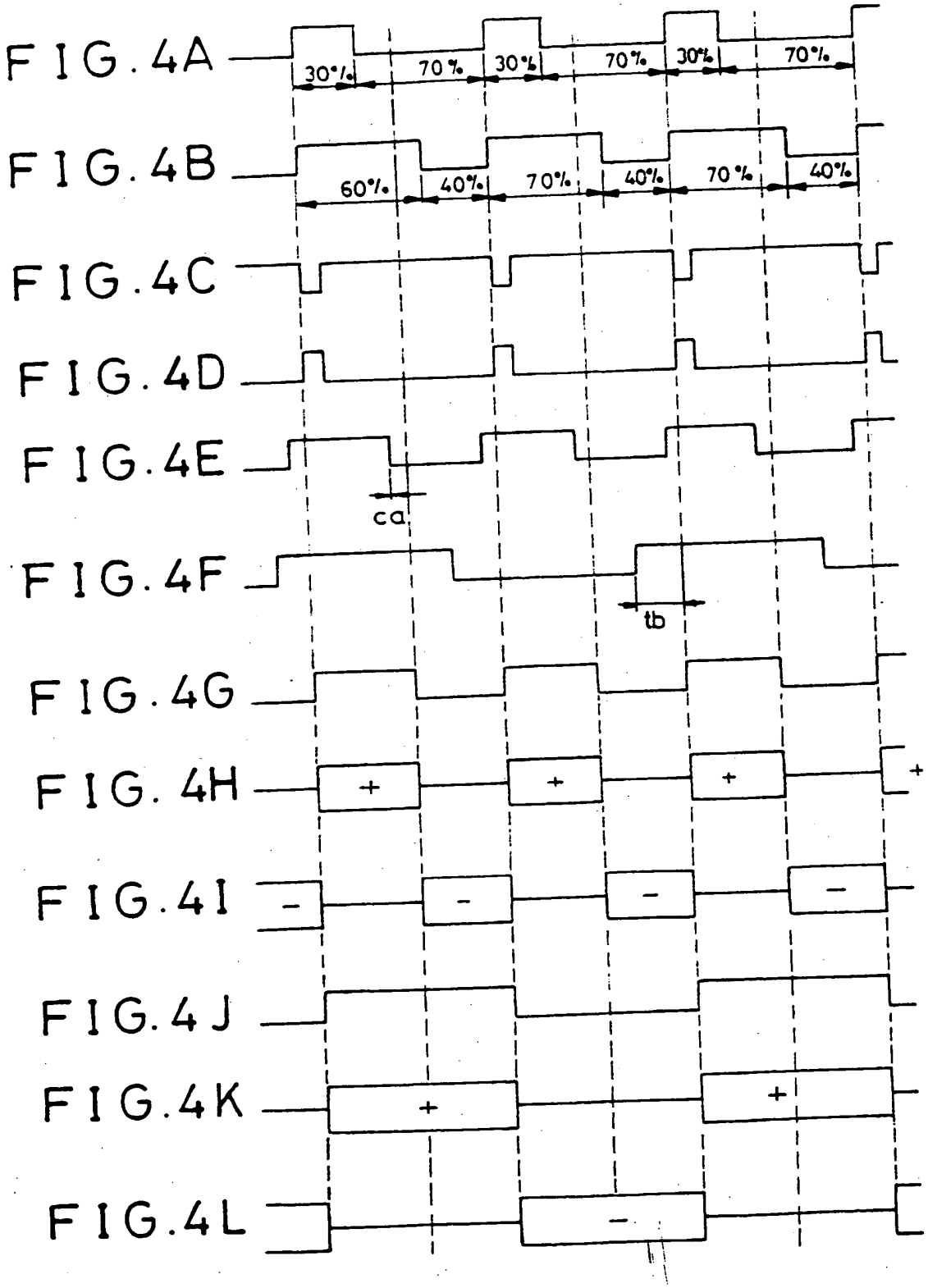
FIG.4A
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30%
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30%
70%
FIG.4B
60%
40%
70%
40%
70%
40%
FIG.4C
FIG.4D
FIG.4E
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FIG.4G
FIG.4H
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FIG.4I
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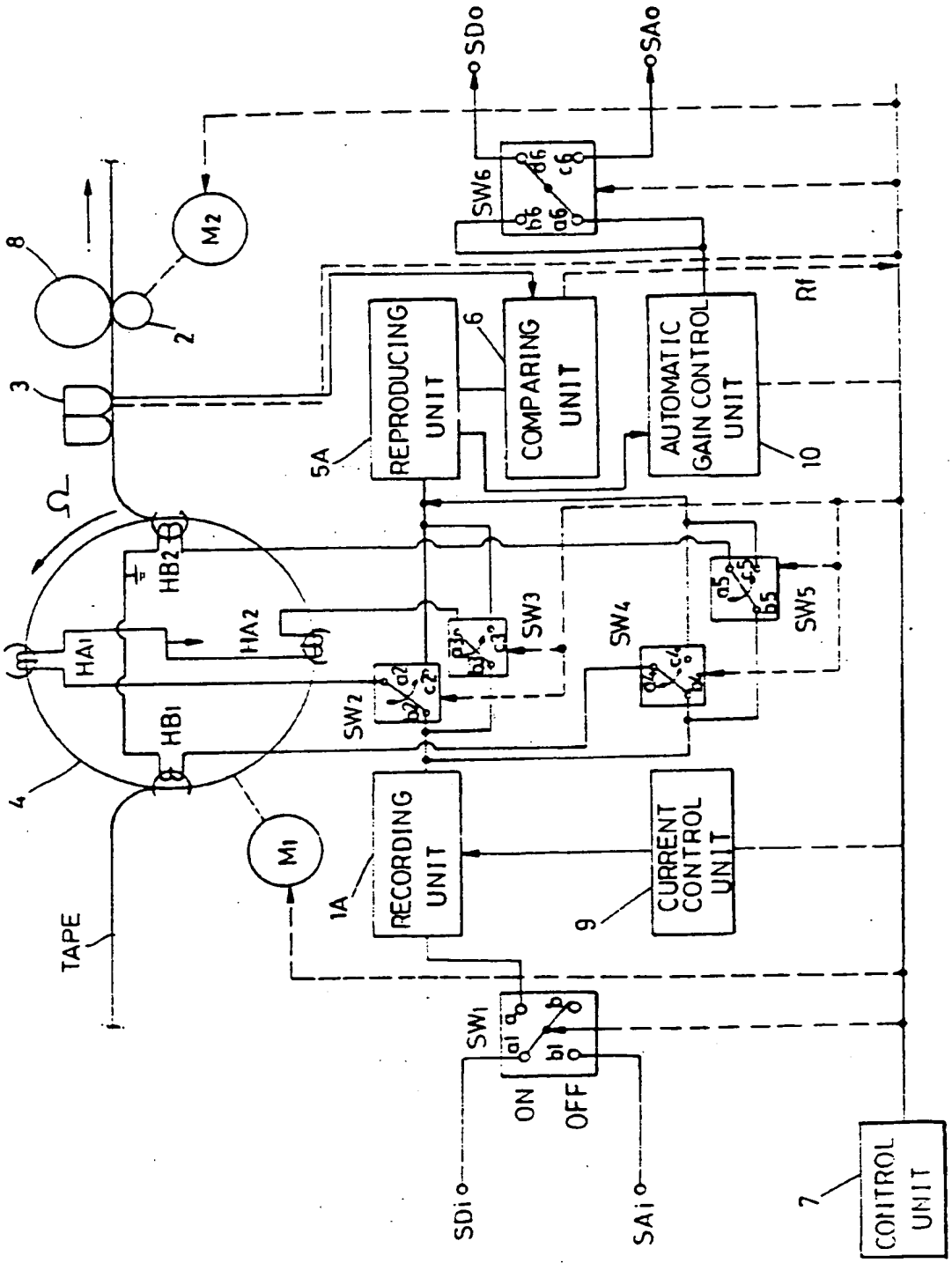
FIG.4J
FIG.4K
FIG.4L

FIG.5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HB1
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5A
COMPARING UNIT
6
AUTOMATIC GAIN CONTROL UNIT
10
Rf
SW3
SW4
SW5
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RECORDING UNIT
1A
CURRENT CONTROL UNIT
9
SW1
ON
OFF
SDi
SAi
7
CONTROL UNIT